

APCTP LECTURE

Pedagogical Lectures on Recent Progress in Higgs Inflation

Kohei Kamada (The University of Tokyo)

August 5-7 Everyday 16:00-

ZOOM Webinar

Introduction

Primordial inflation is now a part of modern cosmology since it elegantly solves several problems in the standard Big Bang cosmology simultaneously. However, the physics that drives inflation is yet far from understood. In light of the discovery of the Higgs particle at the Large Hadron Collider, the first task for cosmologists and particle phenomenologists is to investigate the possibility that the Standard Model Higgs is responsible for inflation. In this lecture, I will introduce the idea of the original Higgs inflation and explain its inherent problems. Then I explain how the extension with R^2 term is a reasonable and promising one and how it is consistent with the original motivation for the investigation to the Higgs inflation. Finally I will introduce recent studies on the cosmological consequences on this extension and discuss future directions.

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APCTP LECTURE

Lecture #1 16:00-17:30 (Seoul/Tokyo) Aug 5, 2020

"Introduction to the pure Higgs inflation".

In the first lecture, I will introduce the basics of the Higgs inflation with the non-minimal coupling to gravity, $\xi H^2 R$ term. Then I explain its cosmological consequences and addresses the problems in the model, such as the Higgs vacuum stability and the unitarity problem.

Refs.

- [1] B.L.Spokoiny, Phys. Lett. B147 (1984) 39
- [2] J.L.Cervantes-Cota and H.DeHnen, Nucl. Phys. B 442, 391 (1995); F.Bezrukov and M.Shaposhnikov, Phys. Lett. B 659 (2008) 703
- [3] F.Bezrukov, J.Rubio, and M.Shaposhnikov, Phys. Rev. D 92 no. 8, (2015) 083512,
- [4] F.Bezrukov, A.Magnin, M.Shaposhnikov and S.Sibiryakov, JHEP 1101 (2011) 016
- [5] Y.Ema, R.Jinno, K.Mukaida, and K.Nakayama, JCAP 02 (2017) 045; M.P.DeCross, D.I.Kaiser, A.Prabhu, C.Prescod-Weinstein, and E.I.Sfakianakis, Phys. Rev. D 97 no. 2, (2018) 023526,

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Lecture #2 16:00-17:30 (Seoul/Tokyo) Aug 6, 2020

"Mixed Higgs- R^2 model as a UV-extension of the pure Higgs inflation"

In the second lecture, I will explain how the unitarity problem in the Higgs inflation is resolved by adding the R^2 term. I will also explain why we can say it is the most natural and inevitable extension of the Higgs inflation from the point of view of the renormalization group approach. Then I will show the dynamics of the model during inflation.

Refs.

- [1] Y.Ema, Phys. Lett. B 770 (2017) 403
- [2] M.He, A.A.Starobinsky, and J.Yokoyama, JCAP 05 (2018) 064
- [3] D.Gorbunov and A.Tokareva, Phys. Lett. B 788 (2019) 37
- [4] Y.Ema, JCAP 09 (2019) 027; Y.Ema, K.Mukaida, and J.van de Vis, arXiv:2002.11739 [hep-ph].

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Lecture #3 16:00-17:30 (Seoul/Tokyo) Aug 7, 2020

"Towards the understanding on the reheating in the Mixed Higgs- R^2 model"

In the final lecture, I will discuss the dynamics of the model after inflation, that is, the reheating process, which is important to identify the model against the cosmological observations. This process is still being investigated and we have not obtained the complete picture. I will argue the future directions in the study of the Higgs inflation.

Refs.

- [1] M.He, R.Jinno, K.Kamada, S.C.Park, A.A.Starobinsky, and J.Yokoyama, Phys. Lett. B 791 (2019) 36
- [2] F.Bezrukov, D.Gorbunov, C.Shepherd, and A.Tokareva, Phys. Lett. B 795 (2019) 657
- [3] M.He, R.Jinno, K.Kamada, A.A.Starobinsky, and J.Yokoyama, 2007.10369 [hep-ph]
- [4] F.Bezrukov, and C.Shepherd, 2007.10978 [hep-ph]